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TRANSLATION NO. 6427-99

(Weapons)

FEDERAL REPUBLIC OF BRAZIL

Ministry of Industry, Trade and Tourism

National Industrial Property Agency



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**LETTERS PATENT # PI 9300292-0**

**Invention Privilege**

**The National Industrial Property Agency,**  
with a view to insuring property rights and the  
exclusive use of a privilege, pursuant to the  
attachments, and in consonance with laws in  
force, and preserving third party rights and  
Government responsibility vis-à-the novelty and  
the usefulness, herewith issues the present  
**Letters Patent,** pursuant to features and  
conditions hereinunder set forth:

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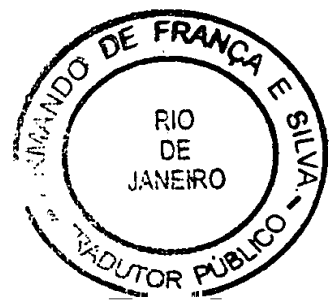
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(54) Title: **IMPROVED NOZZLE VALVE SEATS**

(73) Owner: Petróleo Brasileiro S/A - Petrobrás,  
Mixed Economy Corporation



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10 Period of Validity: 20 (twenty) years as of  
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stipulations.

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signed illegible

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1 P.I.9300292

5 Description of Invention: "Improved Nozzle  
Valve Seats".

**BACKGROUND OF THE INVENTION**

10 The present invention relates to improvements  
in nozzle valve seats, utilized in oil wells  
producing pursuant the continuous gas lift  
procedure.

**DESCRIPTION OF PRIOR ART**

15 In oil wells producing pursuant to  
continuous gas lift procedure, for well  
operations one commonly utilizes a valve normally  
named "nozzle valve". Gas originating from  
annular space between cover - production line  
20 for the latter - flows thru said valve. Said gas  
is responsible for well production pursuant to a  
given flow rate.

25 Nozzle valves are basically composed of a  
nozzle with diameter previously determined (also  
named seat or door) without changes in same as



1 long as valve is located within well area. Gas  
flow thru said nozzle features a high degree of  
irreversibility, thus promoting an expressive  
5 loss of cargo, in addition to rendering difficult  
gas flow rate calculations admitted for passage  
thru same unit, thus compounding both project  
and analysis.

10 **SUMMARY OF INVENTION**

In consonance with the present invention, an  
improved seat of this type of valve is proposed,  
utilizing optimized geometrical seat features,  
according to which gas flow within valve will  
15 resemble an isoentropical flow, considerably  
cutting down side effects effects already  
expressed in the earlier geometry. This new  
proposal is based on the utilization of the so  
called "compact venturi", which implies in  
20 coupling of a convergent mouthpiece with a  
conical diffuser unit. Said device is nearly as  
efficient as a traditional venturi unit, being  
however shorter (which is required in the case of



1 a valve) and being considerably easier to  
manufacture, thus offering lower cost features.

5 Utilization of this geometry will enhance an  
increment of roughly 20% in viable gas flow rate  
thru valve vis-à-vis an identical pressure  
offset between covering and line, or, on the  
other hand, will imply in a 76% - 20% decrease in  
cover pressure required to handle identical gas  
10 flow rate with identical line pressure (the most  
common cases should be close to the upper range  
value).

15 A striking example, evidencing the adequacy  
of said new valve described herein is the case  
of deep water satellite wells, where a host of  
large flow rates with high pressure levels is  
present.

#### 20 **SHORT DESCRIPTION OF DRAWINGS**

The invention will now be described in more  
detail, based on the attached drawings,  
featuring:

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1        Figure 1 - partial cut view of nozzle valve  
of type now utilized with enlarged detail,  
featuring cut of seat;

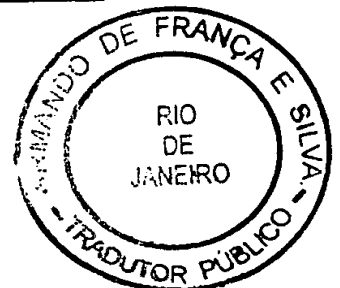
5        Figure 2 - schematic view of detail of seat,  
featured in detail;

      Figure 3 - schematic view of detail,  
featuring cut of seat, illustrating gas flow thru  
same; and

10       Figure 4 - enlarged, schematic cut view of  
improved seat, utilized in nozzle valve.

#### DETAILED DESCRIPTION OF INVENTION

15       Figure 1 evidences a nozzle type pneumatic  
lift valve seat, currently utilized. Figure 1  
evidences point designated "A", indicating gas  
admission to inside valve section, flowing thru  
seat (specifically, the nozzle) "B" and escaping  
thru nose section "C" towards tube inner  
20       section. The same figure 1 outlines a detail of  
cut of said seat, schematically reproduced in  
Figure 2, where a valve cylinder body 1 can be  
noticed, the seat housing 2, seat 4, nozzle 4 and  
25       O-ring 5.



1 It can be seen that seat 3 is simply a disc  
unit with a cylindrical straight hole pursuant  
to diameter desired. General edge shaped  
5 sections are sharp, but there are cases in which  
a small bevelled section 66 is foreseen.

Figure 3 features a flow line scheme thru  
nozzle 4, pursuing a path thru seat 3. Sudden  
contraction and expansion features cause vortexes  
10 originating intense loss of load. In addition,  
the smaller flow area does not occur along the  
restricted section (seat), but farther ahead,  
pursuant to a phenomenon called "vena contracts".

15 Conventional modelling feature consists in  
presupposing isentropical escape (reversible  
adiabatic), with final integration of a  
correction coefficient (discharge coefficient)  
and theoretical results are being compared with  
20 experimental results. Neverthelsss, said  
discharge coefficient is difficult to be  
expressed, since it is contingent upon several  
factors, many being intangible and based on a  
theoretical modelling viewpoint. Subsequently,  
25 project and the continuous gas lift procedure





1 are being handicapped, since these are contingent  
upon correct gas flow rate calculations thru  
valves. On the other hand, irreversibility  
5 factors imply in extra load losses in system  
(which unnecessarily are changed into heat).

With a view to minimizing problems outlined  
above, according to the present invention a novel  
geometry is being proposed for seat 7, shown in  
10 an enlarged schematic cut view in figure 4.

The improved seat 7 features an upper curved  
section 8, an intermediate vertical straight  
section 9 and an inclined lower straight section  
10 with central spacing 11 representing a first  
15 section, featuring a format of a converging  
mouthpiece wherein gas is gradually being  
accelerated, a second portion 13 which is a  
cylindrical section of equal diameter of desired  
nozzle and corresponds to main flux restriction,  
20 and a third section 14, evidencing a conical  
diffuser format, wherein gas is gradually being  
decelerated. With these measures,  
irreversibilities are reduced and the lower flow  
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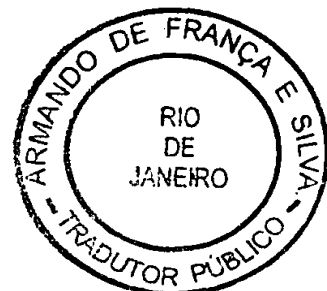


1 rate area coincides with the second section 13,  
avoiding said "vena contracts".

5 The  $\alpha$  angle defining length  $h_1$  of the third  
section 14 is restricted by length available  
(which is more critical for 1 1/2" valves, unless  
changes are being effected in valve body).

10 diameter  $d_1$  may coincide with  $d_\alpha$ , however,  
generally, due to assembly aspects, it should be  
slightly inferior. In the same way, a second  
portion 13 may be theoretically reduced to a  
simple section, however - also due to practical  
questions - should always feature a certain  
15 length  $h_\alpha$ , even of small extent, with  $h_\alpha$   
representing the length of the first section 12  
with outer contours resembling a convergent  
mouthpiece.

20 In applicable literature, said unit is often  
called "compact Venturi", since it resembles the  
common venturi, being much shorter though and  
easy to manufacture, but does not evidence  
remarkable performance levels.



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**C l a i m s**

1. Improved nozzle valve seats used in oil wells pursuant to a continuous pneumatic gas lift operational feature, consisting of a cylinder shaped body (1) into which gas flow is admitted thru an intermediate nozzle (A), passing thru seat (B) and being discharged in lower section thru nose setion (C), characterized in that said improved nozzle valve seat comprises a seat (7), featuring a curved (8) upper section, a straight vertical section (9) and an inclined lower straight section (10) with central spacing (11) representing a first section (12), with a format similar to a convergent mouthpiece in which gas is gradually being accelerated, a second section (13) corresponding to main flow restriction feature, as well as a third section (14) similar to a conical diffuser unit in which gas is gradually being decelerated.

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## A B S T R A C T

Description of invention: "Improved nozzle valve seats".

The present invention relates to improved nozzle valve seats used in oil wells with a continuous gas lift production feature, comprising a seat (7) featuring a curved upper section (B), a vertical straight section (9) and a straight inclined lower section (10) with central spacing (11), representing a first section (12) similar to a convergent mouthpiece, in which gas is being gradually accelerated, a second section (13) corresponding to main flow restriction feature, as well as a third section (14) similar to a conic diffuser unit, in which gas is being gradually decelerated.

Rio de Janeiro, August 23, 1999.

WITNESS MY HAND AND SEAL.

